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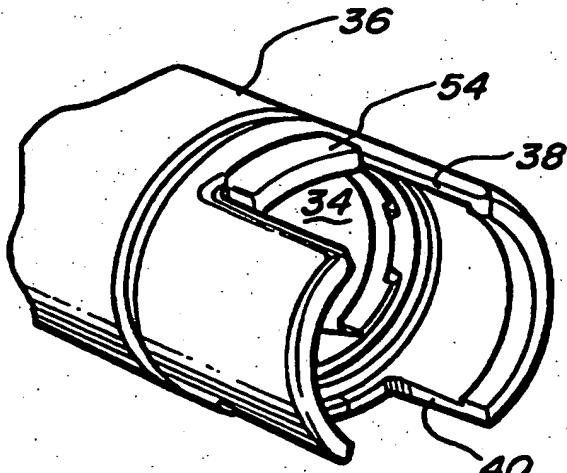
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(54) Title: BATTERY PACK RETAINING LATCH FOR CORDLESS DEVICE

(57) Abstract

A battery retention latch (50, 140) comprises an annular ring member (52, 142), a release button (54, 172, 174) and a spring arm (56, 190, 192, 194, 196). The annular ring (52, 142) retains a battery pack (26) in a cordless device (20, 120) regardless of the angular orientation of the battery pack (26) about a casing axis. The spring arm (56, 190, 192, 194, 196) maintains the ring (52, 142) in a normally engaged position, and upon depressing the push button (54, 172, 174), the battery (26) may be removed from the device (20, 120). Also, a battery retention latch (350) comprises a retaining member (354), a release button (356) and a cam element (362). A biasing member (358) maintains the retention latch in a normally engaged position. The cam element (362) retains a battery pack (26) in a cordless device (352) regardless of the angular orientation of the battery pack (26) about a casing axis. A holding device (382, 394) maintains the battery (26) in the cavity (34) against a spring ejecting force such that the battery (26) partially extends from the device (352) enabling the battery (26) to be removed from the device (352).



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BATTERY PACK RETAINING LATCH FOR CORDLESS DEVICE

FIELD OF THE INVENTION

The invention relates to cordless (i.e. battery operated) devices such as portable electronic devices, toys, power tools or kitchen appliances. More particularly, the present invention relates to a battery pack latching ring to retain the pack in the device.

BACKGROUND OF THE INVENTION

For the consumer market, most cordless devices have a battery pack made integrally in the device housing because of reduced cost, increased user convenience and sturdiness. However, because of the desire to provide consumer devices with detachable packs, simplifying the recycling of the packs, and the desire to provide a family of cordless devices using an interchangeable pack and a single charger, there is a desire to use such a battery pack. Also, it is desirable to retain the battery pack in the device such that the battery pack may be easily coupled with the device and readily removable from the device. Of course, these design goals are not unique to consumer devices, but are equally desirable for professional cordless devices in which detachable packs have been standard for many years.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved battery pack latch to retain the pack in a cordless device and a battery ejecting device embodying the foregoing design objectives.

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In accordance with one aspect of the invention, a battery pack retention latch comprises at least one annular member to couple with the battery to retain it in the device, a release button formed with the at least one annular member, the release button is activated to move the annular member to a release position to enable the battery to be removed from the device, and a spring member to bias the annular member between its coupling or retention position and its release position. The spring member is coupled with the at least one annular member. Preferably, the at least one annular member is a continuous ring with the spring member and release button positioned opposing one another on the ring. The ring is divided into four portions with the first portion adapted to engage the battery pack to removably retain the battery pack in the device. Also, the spring member is an arm integrally formed with the first ring portion extending therefrom to bias the ring in a normally engaged position in the device.

In accordance with a second aspect of the invention, the at least one annular member is an open ring. Here, the annular ring has an overall open figure eight configuration divided into two ring sections having a continuous inner opening and open on one of its sides. Each ring section includes a release button and a spring member and the spring and release member oppose one another on the ring sections. Each ring section has an overall C shape with the Cs being connected to one another in opposing fashion (forming the open figure eight), continuous at one end and open at the other. Each of the C shaped ring sections includes an arcuate flange integrally formed with an engaging portion of the C shaped ring section. The flange engages the battery pack to retain the battery pack in a device

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on the latch. The spring member includes a pair of spring arms extending from the engaging portion of the C shaped ring section.

In accordance with a third aspect of the invention, a cordless device comprises a cavity with a receptacle in the cavity, a battery pack removably located in the cavity with the battery pack including a mechanism for electrically coupling with the receptacle and the device including a retention latch in accordance with either the first or second aspect of the invention described above.

In accordance with a fourth aspect of the invention, a cordless device comprises a cavity with a receptacle in the cavity, the receptacle is adapted to receive a battery and the device includes a retention latch in accordance with either the first or second aspect of the invention described above.

The cordless device includes at least one projection to support the spring member in its normally engaged position and to locate the latch within the device. The device also includes at least one pair of opposing openings in it to enable grasping of the battery pack to remove the battery pack from the cordless device.

In accordance with a fifth aspect of the invention, a method of removing a battery from the device comprises providing a cordless device in accordance with the third aspect, activating the release button and removing the battery.

In accordance with a sixth aspect of the invention, a cap for a battery pack comprises a cylindrical wall with an exterior surface and an interior diameter to fit onto the battery pack and a groove in the exterior surface to engage a retention latch in accordance with either the first or second aspect of the invention described above.

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In accordance with a seventh aspect of the invention, a battery pack retention latch comprises a retaining member to couple with the battery to retain it in the device, a release button formed with the retaining member, the release button is activated to move the retaining member to a release position to enable the battery to be removed from the device, and a spring member to bias the retaining member between its coupling or retention position and its release position. The spring member is coupled with the retaining member. Preferably, the retaining member is L-shaped with the release button positioned at the free end of the vertical leg, a cam element at the free end of the horizontal leg, and the spring positioned in a cut-out in the horizontal leg below the vertical leg. Also, the spring member is a helical spring in the cut-out to bias the retaining member in a normally engaged position in the device. The cam element has a cam face and an opposing retaining face to engage the battery.

In accordance with an eighth aspect of the invention, a cordless device comprises a cavity with a receptacle in the cavity, a battery pack removably located in the cavity with the battery pack including a mechanism for electrically coupling with the receptacle and the device including a retention latch in accordance with the first aspect of the invention described above.

In accordance with a third aspect of the invention, a cordless device comprises a cavity with a receptacle in the cavity, the receptacle is adapted to receive a battery, a spring member is positioned in the cavity to eject the battery, a holding member is in the cavity to maintain the battery in the cavity against the ejecting force of the spring member and the device includes a retention latch in

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accordance with either the first aspect of the invention described above or as disclosed herein.

The latch retains the battery pack in the cavity such that upon release of the latch, the battery pack is partially ejected from the cavity by the ejecting force of the spring member and is held in the cavity by the holding member.

The holding member includes two embodiments. First, an annular member with at least one finger with a detent holds the battery in the cavity against the ejecting force. Second, the holding member is coupled with the receptacle and includes a plurality of spaced fingers to retain the battery against the ejecting force of the spring. Also, the holding member is axially slid able in the cavity.

Additional objects and advantages of the invention will be apparent from the detailed description of the preferred embodiment, the appended claims and the accompanying drawings or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate two embodiments of the present invention and together, with the description, serve to explain the principles of the invention. In the drawings, the same reference numerals indicate the same parts.

FIG. 1 is a side view, partially in cross section, of a cordless device in accordance with the present invention.

FIG. 2 is a cross sectional view of the cordless device of FIG. 1 along line 2-2 thereof.

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FIG. 3 is a perspective view of a retaining latch in accordance with the present invention.

FIG. 4 is a cross sectional view of FIG. 1 along line 4-4 thereof in an engaged position.

FIG. 5 is a view like FIG. 4, with the latching ring in a disengaged position.

FIG. 6 is a rear plan view of the latch of FIG. 3.

FIG. 7 is a cross sectional view of FIG. 6 along line 7-7 thereof.

FIG. 8 is a side view partially in section of a second embodiment of a cordless device in accordance with the present invention.

FIG. 9 is a side plan view, partially in section, of the cordless device of FIG. 8.

FIG. 10 is a perspective view of a second embodiment of a retaining latch ring in accordance with the present invention.

FIG. 11 is a cross sectional view of FIG. 8 along line 11-11, with the latch in an engaged position.

FIG. 12 is a view like that of FIG. 11 in a transition position.

FIG. 13 is a view like FIGS. 11 and 12 with the latch in a disengaged position.

FIG. 14 is a front plan view of the latch in accordance with the present invention.

FIG. 15 is a cross sectional view of FIG. 14 along line 15-15 thereof.

FIG. 16 is a partial perspective view of the cordless device of FIG. 8.

FIG. 17 is a partial perspective view of the cordless device of FIG. 1.

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FIG. 18 is a perspective view of a cap in accordance with the present invention.

FIG. 19 is a perspective view of an additional embodiment of the present invention.

FIG. 20 is a cross section view through the embodiment of FIG. 19 along line 20-20 thereof.

FIG. 21 is a view like FIG. 20 with the battery in a held ejection position.

FIG. 22 is a perspective view of a latch in accordance with the present invention.

FIG. 23 is a cross section view of another embodiment of the present invention.

FIG. 24 is a cross section view like FIG. 23 with the battery in a held ejection position.

FIG. 25 is a perspective view of a holding device in accordance with the present invention.

FIG. 26 is a cross section view of the holding device of FIG. 25.

FIG. 27 is a perspective view of another embodiment of a holding device in accordance with the present invention.

FIG. 28 is a cross section view of the holding device of FIG. 27 in a latched position.

FIG. 29 is a cross section view like FIG. 28 with the battery in the held ejected position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention is a cordless (i.e. battery operated) device, such as a portable electronic device, toy, kitchen appliance or power tool. Examples of such a device are a cordless screw driver 20 and drill 120 as shown in FIGS. 1, 2 and 8, 9, respectively. The preferred embodiment, more particularly, is an improved retention latch 50, 140 to retain battery packs 26 in the device 20, 120.

As shown in FIGS. 1 and 2, in accordance with the present invention, a cordless device 20, herein exemplified as an in-line screw driver, comprises a housing 24 to receive a battery pack 26, a motor (not shown), an output spindle 28, a gear train (not shown) intermediate the motor and spindle, and a receptacle 30 to electrically connect battery pack 26 to the motor through a motor control circuit (not shown) including on and off and speed control switch 32. Housing 24 further includes a generally cylindrical cavity 34 and a handle portion 36 of the housing 24 to receive battery pack 26 in receptacle 30. Also, the housing 24 includes a pair of opposing housing openings 38 and 40 which enable removal of the battery pack 26 from the housing 24. Optionally, a spring 23 may be positioned in the housing cavity 34 to provide an ejection force to remove the battery pack from the housing upon removal of the retention force.

According to one aspect of the invention, the battery pack 26 is removably located in the cavity 34 and is electrically connectable to the receptacle 30 regardless of the angular orientation of the battery pack 26 about a longitudinal axis of symmetry of the pack 26 (this aspect of the invention is sometimes hereinafter referred to as the universal angular orientation feature). The pack 26

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is thus easier to use and may be easily loaded in device 20 under adverse conditions such as in dim light or in cramped quarters.

Battery pack 26 is fully described in U.S. Patent Application No. 08/065,736 for "Battery Pack For Cordless Device", filed May 21, 1993, the specification and drawings of which are herein expressly incorporated by reference. Thus, a detailed description of the battery pack 26 will not be given and only those elements which are necessary for the description will be described.

Battery pack 26 comprises an elongated cylindrical tubular metal casing 235 having opposed rear and forward ends 237 and 239. A plurality of electrically connected mechanically disconnected cells 241, 243, 244 are disposed end to end in casing 235. For simplicity, pack 26 is illustrated in FIG. 2 with three cells 241, 243, 244. However, the present invention is equally applicable to packs including two or more cells. Each cell 241, 243, 244 has a cell can 241a, 243a, 244a for forming a first cell terminal and a button terminal 241b, 243b, 244b closing one end of the cell and forming a second cell terminal. As is conventional, the first or cell can terminal 241a, 243a, 244a is negative and the second or button terminal 241b, 243b, 244b is positive. The cells 241, 243, 244 are preferably nickel cadmium cells which are preferred for high discharge rate applications (5 to 30 amps) such as power tools and certain kitchen appliances. However, the present invention is also equally applicable to other rechargeable and primary cell couples such as nickel, metal hydride or primary alkaline cells.

The top 253 closes the casing forward end 239, is electrically connected to button terminal 243b and forms a second pack terminal 254. Top 253 is radially symmetrical about the casing axis and defines a cavity 255 in the casing forward

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end 239. A forwardly projecting nipple 257 formed on the top 253 is fully recessed within cavity 255 and terminates rearwardly to a forward edge of casing 235. Top 253 is electrically connected to and mechanically disconnected from forward cell 243 through engagement with button terminal 243b. As will be appreciated, first and second pack terminals 246, 254 and 255 have opposite polarities (preferably, negative and positive, positive, respectively), are coaxial with the casing axis and are located adjacent to the casing forward end 239 and, for those reasons, pack 26 is easily connectable in the cordless device 20 with receptacle 30 regardless of the angular orientation of the pack 26 about the pack axis. To electrically insulate each cell 241, 243, 244 from casing 235, the cells 241, 243, 244 are enclosed with an electrically insulated sleeve 277.

The cap 29 has a cylindrical wall 31 with an exterior surface and an interior diameter to fit over the metal housing of the battery pack 26. The cap 29 is secured to the pack 26. The cylindrical wall 31 has an open end 33 and a closed dome shaped end 35, however, the closed end could likewise be open. The dome end 35 acts as a shock absorber in the event the battery is dropped on a surface. Adjacent the open end 33 is an angled peripheral surface 25 on the external surface. The angle surface 25 acts as a cam to enable passage of the cap 29. A latch keeper groove 27 is formed in the external surface of the cylindrical wall 31 to provide an engaging recess for the retention latch 50, 140. Gripping members 37 are peripherally formed on the exterior surface of the cylindrical wall to aid in grasping of the cap 29 to remove the pack 26 from the housing 24. The cap includes a bead 39 on its interior surface to secure it with a recess 281 in the pack casing 235.

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The latch 50 is positioned transversely to the housing 24 to retain the battery 26 within the cavity 34. The latch 50 couples with a latch keeper groove 27 formed in the battery pack cap 29. The latch 50 includes a latch ring 52, a push button 54 and a spring means 56 coupled to latch ring 52. In this embodiment, spring means 56 is preferably constituted by forwardly extending cantilevered spring arm 56 and is for biasing latch ring 52 between a normally engaged position (FIG. 4) and a release position (FIG. 5). Alternatively, spring means 56 may be constituted by a torsion spring (not shown) coupled to one side of ring 52 or may be constituted by a first forwardly extending cantilevered spring arm and a second rearwardly extending cantilevered spring arm. The use of forwardly and rearwardly extending arms would be desirable in devices that can accommodate a latch of greater length and would have the advantage that the mounting of latch ring 52 would be more stable and balanced. The ring 52 is positioned within the housing 24 in a groove 60 formed by a pair of radially inwardly extending walls 62, 64 in the housing 24 (FIG. 2). Also, the cantilevered spring arm 56 is located in a recess 66 in the housing 24. The distal end 55 of the spring arm 56 is supported on a housing projection 68 to locate the latch ring 52 in a normally engaged position. The spring constant of spring arm 56 may be easily varied by changing its shape and thickness. Also, the spring force of spring arm 56 may be easily varied by changing the height or location of projection 68. And thus, latch 50 may be easily adapted to the requirements of the embodiment shown in FIGS. 1-7 and other applications.

Turning to FIGS. 3 through 7, the latch 50 is shown. The latch ring 52 includes ring portions 72, 74, 76 and 78. The first ring portion 72 acts as the

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battery engaging portion which engages the latch keeper groove 27 formed in the battery pack cap 29. The spring arm 56 extends from this portion 72 of the ring 52. The ring portions 74 and 76 are transition portions and extend on each side of the continuous ring 52 and include reinforcement tabs. To guide movement of ring 52, each ring portion 74, 76 has a flat outer surface 75, 77 in sliding engagement with a respective inner flat web between sidewalls 62, 64. Fourth ring portion 78 opposes the first ring portion 72 and includes the unitarily formed push button 54. As can be seen in the figures, the ring 52 has an elliptical shape with a first radius 71 defining the arc of the first ring portion 72 with substantially parallel arcs or lines on the ring portions 74 and 76 and a second radius 77 defining the arc of the fourth ring portion 78. The radii 71, 77 of the first and fourth ring portions 72 and 78 are different such that the second 74, third 76 and fourth 78 ring portions do not engage the battery latch keeper groove 27 in an engaged or disengaged position. Also, this design aids in the movement of the latch ring 56 such that when the push button 54 is pushed radially of the housing 24, the ring 52 is moved laterally downward without bowing its annular portion and is disengaged by flexing spring arm 56 in the housing recess 66. Thus, ring 52 is located in the disengaged position shown in FIG. 5. The annular portion of the ring 52 is guided by and prevented from bowing by the web between sidewalls 62, 64 of the housing 24, as seen in FIG. 2. Further, flat surfaces 75, 77 aid in reducing friction and prevent rotation of ring 52 about the longitudinal axis of handle 36.

The engagement ring portion 72 includes an angled cam surface 82 which assists to enable the battery 26 to pass through the ring 52 as the battery cap 29

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contacts the cam surface 82, assisting the battery 26 to slide through the latch opening 51.

The latch 50 is ordinarily formed from a polymeric material such as acetel forming the latch 50 as a unitary one piece device. However, the latch 50 may be manufactured from several different parts pieced together to form a desired latch member. Also, the latch could be made of a metallic material or a metallic material coated with a polymeric material.

The distal end 55 of the arm 56 is supported on the housing projection 68 to locate the latch ring 52 in a normally engaged position (FIGS. 1, 2 and 4). Here, the first ring portion 72 of the ring 52 is engaged on or latched in the cap groove 27. When the push button 54 is pushed radially inward of the housing, ring 52 is moved laterally downward (without bowing its annular position) and is disengaged by flexing spring arm 56 into the recess 66. Thereby, ring 52 is located in the disengaged position shown in FIG. 6. The annular portion of the ring 52 is prevented from bowing by the radially inward housing web between side walls 62, 64 (FIG. 2).

To insert the battery pack 26 into the housing 24, the battery pack 26 is inserted into the housing 24 in any angular orientation and is freely slidable in the housing cavity 34 until the first latch ring portion 72 engages the forward tapered rim 25 of the battery cap 29. The rim 25 functions as a camming surface with the camming surface 82 of the first ring portion 72 and bends arm 56 outwardly as battery pack 26 is manually forced into the cavity 34. In this manner, ring 52 slides over rim 25 and is biased resiliently inward into the cap groove 27 by spring arm 56 to assume the engaged position shown in FIGS. 1, 2 and 4. To disengage

battery pack 26, the release button 54 is pushed radially inwardly, normally by the user's thumb, to flex spring arm 56 into the housing recess 66. Thereafter, battery pack 26 can be pulled axially outwardly from the cavity 34 by the index finger on the same hand of the user by gripping or grasping the gripping members 37 of the cap 29 through one of the opposed housing openings 38, 40.

In accordance with another feature of the present invention, cordless device 120, herein exemplified as a drill, comprises a housing 122 for receiving battery packs 26, a motor, not shown, an outer spindle 124, a gear train (not shown) intermediate the motor and spindle 124, and a receptacle 126 for electrically connecting the battery packs 26 to the motor through a motor control circuit (not shown), including on/off and speed control switch 128. Springs (not shown) like the one previously described could be used to provide an ejection force. Housing 122 further includes cylindrical cavities 130 and 132 in a handle portion 134 of the housing 122 to receive battery packs 26 in receptacle 128. The battery packs 26 are the same as those previously defined with the invention being directed to a retention latch 140 positioned within the housing handle 134.

The latch 140 comprises a latch double ring 142 mounted in the drill handle 134 and latch keeper grooves 27 formed in the battery pack caps 29. The double ring 142 is located transversely of the handle 134 and is coupled to a spring means 144, 146 for biasing latch ring 142 between a normally engaged position (FIG. 11) and a release position (FIG. 12). In this embodiment, spring means 144, 146 is preferably constituted by a pair of forked cantilevered spring arms 144, 146. As in the case of the embodiment shown in FIGS. 1-7, the spring means may also be constituted by a torsion spring or by forwardly and rearwardly extending spring

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arms. The ring 142 is seated in a transverse channel 150 defined by a pair of radially extending parallel spaced walls 154 and 156 and is laterally slideable in a plane perpendicular to the battery pack axes. The spring arms 144 and 146 are supported on projections 158 on the interior of the handle 134 to locate the latch ring in a normally engaged position, as shown in FIGS. 8, 9 and 11.

As shown in the figures, the double ring 142 has an overall open figure eight configuration which is open inside the annular regions. Each ring 160, 162 is C shaped, being connected at one end 164, 166 and being free at the other 168, 170. The free ends 168, 170 of the rings 160, 162 include an integrally or unitarily formed push button 172, 174 which enables movement of the latch rings 160, 162. Opposing the push buttons 172, 174 are engagement portions 176 and 178 of the C shaped rings 160, 162. The engagement portions 176 and 178 include integrally or unitarily formed arcuate flanges 182 and 184 that are latched, respectively, in the battery pack grooves 27. The spring arms 144, 146 extend from the engaging portion 176, 178 of the C shaped rings 160, 162. Thus, the arms 144, 146 also oppose the push button members 172, 174. Further, preferably each spring arm 144, 146 includes a pair of arms 190, 192, 194, 196. As mentioned above, the pair of arms 190, 192, 194, 196 are supported on projections 158 to locate the latch ring 142 in a normally engaged position as shown in FIG. 11.

As seen in FIGS. 11 and 12, the pair of integrally formed arcuate flanges 182, 184 are latched, respectively, in cap grooves 27. The latch 140 is designed such that the battery packs 26 can be selectively removed one at a time. To disengage one of the packs 26, the push button 172 is pushed laterally towards

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the battery pack 26 by the user's thumb to disengage the flange 182 from the cap groove 27 by primarily resiliently bending the spring arms 190, 192. The annular portions of the ring 142 are designed such that the bending of the annular portions 160 is slight when flexing the spring arms 190, 192. Also, the ring 160 may pivot slightly about a point 200 when disengaging the flange 182 from the groove 27. Thus, the battery 26 may be removed from the cavity 130 by gripping or grasping with the index finger of the same hand the gripping member 37 of the cap 29 through one of the opposed housing openings 202, 204. Regardless, the other flange 184 remains engaged in the groove 27 when the push button 172 is pushed to the disengagement position. The other battery pack 26 is removable from the handle 134 by pushing the other push button 174 to disengage the flange 184 from the groove 27 in an analogous manner. Likewise, the cap 29 would be gripped with an index finger through one of the opposing housing openings 206, 208.

To insert the battery packs 26 in the handle 134, the pack 26 is inserted into the handle 134 in any angular orientation and is freely slidable in the handle cavities 130, 132 until the flange 182, 184 engages the forwardly tapered rim 25 of the cap 29. The cap rim 25 functions as a camming surface and bends the spring arm 190, 192, 194, 196 outwardly as the battery pack 26 is manually forced into the cavity 130, 132. In this manner, flange 182, 184 of the ring 160, 162 slides over the cap rim 25 and is resiliently biased inward into the cap groove 27 by the spring arm 190, 192, 194, 196 and somewhat by the other spring arm 194, 196, 190, 192 to assume the engaged positioned shown in FIG. 11. The

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other battery pack 26 may be inserted into the cavity 132, 130 in the handle 134 in an analogous manner.

As mentioned above, the latch 140 can be manufactured from a plethora of materials, including polymeric materials such as nylon, metallic materials or metallic coated materials. Also, the latch 140 may be a unitary one piece device or it may be formed by several independent members. Referring to Figures 19 through 26, additional embodiments are shown. Like elements are identified with the same reference numerals.

The latch 350 is positioned transversely to the housing 352 to retain the battery 26 within the cavity 34. The housing 352 is similar to that previously described, however the differences will be described in further detail. The latch 350 couples with the latch keeper groove 27 formed in the battery cap 29. The latch 350 includes a retaining member 354, a push button 356, and a biasing spring 358.

The retaining member 354 has an overall L-shape when viewed in side elevation with the push button 356 at the free end of the vertical leg 360 and a cam element 362 positioned at the free end of the horizontal leg 364. The horizontal leg 364 includes a cut-out 366 which retains the spring 358 in contact with the retaining member 354.

The cam element 362 has an overall trapezoidal shape when viewed in front elevation. A pair of cam surfaces 370 are inclined and enable passage of the battery 26 past the cam element 362 into the cavity 34. Likewise, a pair of retaining faces 372 oppose the cam faces 370 which retain and block the battery 26 in the keeper groove 27 of the battery cap 29.

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As can be seen in Figures 20 and 21, as the push button 356 is activated, which in turn compresses the spring 358, the retaining face 372 moves transversely with respect to the keeper groove 27 and moves below the battery cap 29 whereupon the battery may be removed from the cavity 34. The spring 358 is generally a helical spring, however any type of spring may be utilized to perform the biasing function. Also, as can be seen, other than the spring 358, the latch is formed as a one-piece unit usually injection molded from a desired plastic material or the like.

Also, the vertical leg 360 includes a pair of elongated tabs 374 on its longitudinal side edges which retain the latch 350 within grooves 376 within the housing 352. Thus, the latch 350 is enabled to easily move up and down as it is activated and pushed back in position by the biasing spring 358.

Turning to the housing 352, as can be seen, the housing includes a spring 380 and a electrical receptacle 382. The spring 380 is a helical spring which is used to bias the battery 26 out of the cavity upon activation of the latch 350. Upon pressing of the push button 356, the spring 380 biases the battery out of the housing 352.

The electrical receptacle 382 includes at least one, preferably a plurality of fingers 384 to retain the battery onto the electrical receptacle 382. The fingers 384 are compressed together upon receiving the projecting nipple 257 on the top 253 of the battery 26. When the nipple 257 contacts the fingers 384, the fingers are compressed and exert a retaining gripping force onto the projecting nipple 257. The gripping force of the fingers 384 is larger, in magnitude, than the spring force so that upon activation of the latch 350 the spring will eject the battery 26 from

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the cavity while the electrical receptacle 382 retains the battery within the cavity so that a portion of the battery is extended from the cavity 34 as seen in FIG. 20. Thus, the user can readily grab hold of the battery cap and exert a pulling force on the battery cap which overcomes the force of the retaining fingers 384 which, in turn, enables removal of the battery from the cavity 34.

Also, the electrical receptacle 382 includes a cylindrical post 386. The cylindrical post 386 axially slides in an electrical connector 388 to enable electrical receptacle 382 to axially move in the cavity 34 which, in turn, enables the battery to be moved partially out of the housing 352. The electrical receptacle 382 is ordinarily of an electrical connecting material so that proper electrical connection is made between the battery and motor of the device. Also, as shown, the spring is positioned circumferentially about the cylindrical post 386 connected to a housing seat 390 so that the spring pushes on the top of the battery 352. Likewise, the fingers could be reverted forming a cavity between the post and fingers so that a spring could be positioned within the cavity so that the spring could bias the receptacle instead of the battery.

The housing 352 includes two cavities 34 for holding two batteries. The above discussion of the cavity and receptacle apply to both cavities.

Turning to FIGS. 23 through 26, an additional embodiment is shown. An additional housing 390 is illustrated with a retainer latch which is the same as latch 50 described above. The housing 390 includes a biasing spring 392 to eject the battery 26 from the housing 390 as previously explained. Also, the housing includes a holding member 394 which maintains the battery 26 in the housing against the force of the spring 392.

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The holding member 394 has an overall annular shape with a ring portion 396 and at least one, preferably a plurality of extending fingers 398. The ring 396 has an annular cam surface 400 which enables the battery 26 to pass into the holding member 394. Also, the ring 396 includes a pair of tabs 402 which enable the holding member 394 to axially move in slots 404 of the housing 390. The tabs 402 abut against blocking members 406 in the housing 390 which stop the axial movement of the holding member 394 against the spring force. Thus, the tabs 402 stop the axial movement so that the battery 26 only extends a desired distance out of the housing 390 as illustrated in FIG. 24.

The fingers 398 extend from the ring 396 and have a curved end 410. Also, the fingers include an interior extending detent 412. As the battery 26 passes into the holding member 394, the top 352 of the battery casing abuts the curved ends 410 of the fingers and the detent 412 snaps into the radial groove on the battery top 253.

The spring 392 exerts a force on the curved ends 410 of the holding member which in turn move the holding member 394 axially in the housing. The tabs 402 abut the stops 406 whereupon the battery extends a desired distance out of the cavity. Thus, the user can grab the cap 29 of the battery, pull on the battery overcoming the force of the detents 412, pushing the fingers 398 outward and enabling the battery to be removed from the cavity 34.

Turning to FIGS. 27 through 29, an additional embodiment is shown. A terminal assembly 420 is illustrated including an insulating support 422, a negative terminal 424 and a positive terminal 426. The negative and positive terminals 424, 426 are riveted to the insulative support board 422. The positive terminal

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426 includes a pair of extending fingers 428 which engage the battery pack terminal, thus electrically connecting the battery to the motor.

The negative terminal 424 includes an arcuate base 429 terminating in a spring portion 430 for ejecting the battery pack 26. Also, the negative terminal includes a cantilevered arm 432 which serves as an electrical connection to the battery pack sidewall. Also, the cantilever arm 432 includes a detent 434 which engages the annular recess in the battery pack 26.

Turning to FIG. 28, the battery pack is illustrated in a latched position. In this position, the spring arm 430 is flattened and the cantilevered arm detent 434 is disengaged from the annular recess 436 in the battery pack 26. As shown, the positive terminal 426 is engaged with the battery pack terminal.

FIG. 29 illustrates the battery pack in an unlatched position. In the unlatched position, the spring portion 430 returns to its relaxed position which, in turn, ejects the battery pack 26 from the housing 24. As the battery pack 26 is ejected from the housing, the cantilevered arm detent 434 engages the annular recess in the battery 26 to retain the battery pack 26 in the housing. As can be seen, a portion of the battery pack 26 extends from the housing 24 so that the user may readily grab the battery and pull it from the housing which overcomes the retention force of the cantilevered arm 432 to enable the battery to be pulled from the housing.

By eliminating retention latch from the battery itself and positioning the latch within the housing, the batteries may be smaller and are able to nest with one another in a group in close proximity to one another. Also, the latch is more durable when enclosed in the housing, prohibiting easy break off like that which

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occurs when the latch is on the battery. Other advantages will be apparent to those skilled in the art.

It will be recognized that although latches 50, 140 have been described as preferably generally annular or circular, other configurations may be used consistent with the geometry of the device in which the latch is used. For example, rectangular and octagonal configurations may be used. Such configurations may also be open to form a generally C-shaped configuration, if desired.

It will be apparent to those skilled in the art that various modifications and variations may be made in the cordless device and latch of the present invention without departing from the scope or the spirit of the present invention. Thus, it is intended that the present invention cover these modifications and variations provided they come within the scope of the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. A retention latch adapted to be positioned within a device for retaining a battery or the like in the device, said retention latch comprising:
 - at least one annular member, said annular member adapted for engaging with the battery;
 - a release member coupled with said at least one annular member, said release member adapted to be activated to move said annular member to a release position to enable the battery to be removed from the device; and
 - spring means for biasing said annular member between a normally engaged position and its release position, said spring means coupled with said at least one annular member.
2. The retention latch according to claim 1, wherein said at least one annular member is a continuous ring.
3. The retention latch according to claim 1, wherein said at least one annular member is an open ring.
4. The retention latch according to claim 1, wherein said release member and spring means are positioned on said annular member opposing one another.

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5. The retention latch according to claim 2, wherein said annular ring has an elliptical opening and is divided into first, second, third and fourth ring portions, said first ring portion opposing said fourth ring portion and said second and third ring portions opposing one another and connecting said first and fourth ring portions, said first and fourth ring portions having different radii.

6. The retention latch according to claim 5, wherein said first ring portion is adapted to engage the battery to removably retain the battery in the device.

7. The retention latch according to claim 6, wherein said first ring portion includes an angled face acting as a cam surface for assisting in enabling passing of the battery through the annular member.

8. The retention latch according to claim 5, wherein when said first ring portion engages the battery in an engaged retention position, said second, third and fourth ring portions disengage the battery.

9. The retention latch according to claim 5, wherein when the release member is activated to move the annular member to a release position, said first ring portion disengages from the battery and said first, second, third and fourth ring portions move without bowing enabling removal of the battery.

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10. The retention latch according to claim 5, wherein said first ring portion has a thickness greater than a thickness of the second, third and fourth ring portions.

11. The retention latch according to claim 5, wherein said spring means is integral with said first ring portion.

12. The retention latch according to claim 11, wherein said spring means is a spring arm extending from said first ring portion.

13. The retention latch according to claim 12, wherein said spring arm is adapted to locate said latch in the device.

14. The retention latch according to claim 1, wherein said spring means is a spring arm extending from said annular member.

15. The retention latch according to claim 14, wherein said spring arm is adapted to locate said latch in the device.

16. The retention latch according to claim 3, wherein said at least one annular member has an overall open figure eight configuration being divided into two ring sections having a continuous inner opening and open on one side.

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17. The retention latch according to claim 16, wherein each ring section includes a release member and a spring means.

18. The retention latch according to claim 17, wherein each said release member is positioned on said ring section opposing its respective spring means.

19. The retention latch according to claim 18, wherein each ring section has an overall C shape with the C shapes opposing one another and continuous at one end and open at its other end with each said release member integral with said C shaped ring section adjacent the open end.

20. The retention latch according to claim 19, wherein each said C shaped ring section includes an engaging portion opposing said release member.

21. The retention latch according to claim 20, wherein each said engaging portion includes a raised arcuate flange integrally formed on said engaging portion.

22. The retention latch according to claim 20, wherein each said arcuate flange is adapted to engage the battery in an engaged retention position and the remainder of the C shaped ring section is disengaged from the battery.

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23. The retention latch according to claim 22, wherein when said release member is activated to move the C shaped ring section to its release position, said flange disengages from the battery and the remainder of the C shaped ring section bends slightly while the spring means bends enabling removal of the battery.

24. The retention latch according to claim 23, wherein said spring means is integral with said engaging portion.

25. The retention latch according to claim 24, wherein said spring means includes at least one spring arm extending from said engaging portion.

26. The retention latch according to claim 25, wherein said spring means includes a pair of spring arms.

27. The retention latch according to claim 25, wherein said spring arms are adapted to locate the latch in the device

28. The retention latch according to claim 17, wherein said spring means includes at least one spring arm extending from said ring section.

29. The retention latch according to claim 28, wherein said spring means includes a pair of spring arms.

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30. The retention latch according to claim 28, wherein said spring arms are adapted to locate the latch in the device.

31. A cordless device comprising:

a cavity;

a receptacle in the cavity;

a battery pack removably located in the cavity, said battery pack

including means for electrically coupling with said receptacle; and

a latch for retaining said battery in said cavity, said latch including at least one annular member, said annular member engaging with the battery to retain said battery in said cavity;

a release member coupled with said at least one annular member, said release member adapted to be activated to move said annular member to a release position to enable the battery to be removed from the device; and

spring means for biasing said annular member between a normally engaged position and its release position, said spring means coupled with said at least one annular member.

32. The device according to claim 31, wherein said cavity includes at least one projection for supporting said spring means and for locating said latch in said normally engaged position.

33. The device according to claim 31, wherein said battery includes a groove for coupling with said annular member.

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34. The device according to claim 31, further including at least one pair of opposed openings in said cordless device for enabling grasping of said battery for removal from said cordless device.

35. The retention latch according to claim 34, wherein said at least one annular member is a continuous ring.

36. The retention latch according to claim 34, wherein said at least one annular member is an open ring.

37. The retention latch according to claim 34, wherein said release member and spring means are positioned on said annular member opposing one another.

38. The retention latch according to claim 35, wherein said annular ring has an elliptical opening and is divided into first, second, third and fourth ring portions, said first ring portion opposing said fourth ring portion and said second and third ring portions opposing one another and connecting said first and fourth ring portions, said first and fourth ring portions having different radii.

39. The retention latch according to claim 38, wherein said first ring portion engages said battery to removably retain said battery in the device.

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40. The retention latch according to claim 39, wherein said first ring portion includes an angled face acting as a cam surface for assisting in enabling passing of said battery through the annular member.

41. The retention latch according to claim 38, wherein when said first ring portion engages said battery in an engaged retention position, said second, third and fourth ring portions disengage said battery.

42. The retention latch according to claim 38, wherein when the release member is activated to move the annular member to a release position, the first ring portion disengages from the battery and the first, second, third and fourth ring portions move without bowing enabling removing of the battery.

43. The retention latch according to claim 38, wherein said first ring portion has a thickness greater than a thickness of the second, third and fourth ring portions.

44. The retention latch according to claim 38, wherein said spring means is integral with said first ring portion.

45. The retention latch according to claim 44, wherein said spring means is a spring arm extending from said first ring portion.

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46. The retention latch according to claim 45, wherein said spring arm is adapted to locate said latch in the device.

47. The retention latch according to claim 34, wherein said spring means is a spring arm extending from said annular member.

48. The retention latch according to claim 47, wherein said spring arm is adapted to locate said latch in the device.

49. The retention latch according to claim 36, wherein said at least one annular member has an overall open figure eight configuration being divided into two ring sections having a continuous inner opening and open on one side.

50. The retention latch according to claim 49, wherein each ring section includes a release member and a spring means.

51. The retention latch according to claim 50, wherein each said release member is positioned on said ring section opposing its respective spring means.

52. The retention latch according to claim 51, wherein each ring section has an overall C shape with the C shapes opposing one another continuous at one end and open at its other end with each said release member coupled with said C shaped ring section adjacent the open end.

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53. The retention latch according to claim 52, wherein each said C shaped ring section includes an engaging portion opposing said release member.

54. The retention latch according to claim 53, wherein each said engaging portion includes a raised arcuate flange integrally formed on said engaging portion.

55. The retention latch according to claim 54, wherein each said arcuate flange engages said battery in an engaged retention position and the remainder of the C shaped ring section disengages the battery.

56. The retention latch according to claim 55, wherein when said release member is activated, to move the C shaped ring section to its release position, said flange disengages from said battery and the remainder of the C shaped ring section bends slightly while the spring means bends enabling removal of the battery.

57. The retention latch according to claim 56, wherein said spring means is integral with said engaging portion.

58. The retention latch according to claim 57, wherein said spring means includes at least one spring arm extending from said engaging portion.

59. The retention latch according to claim 58, wherein said spring means includes a pair of spring arms.

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60. The retention latch according to claim 58, wherein said spring arms are adapted to locate the latch in the device.

61. The retention latch according to claim 50, wherein said spring means includes at least one spring arm extending from said annular member.

62. The retention latch according to claim 61, wherein said spring means includes a pair of spring arms.

63. The retention latch according to claim 61, wherein said spring arms are adapted to locate the latch in the device.

64. A cordless device comprising:
a cavity;
a receptacle, said receptacle adapted to receive a battery; and
a latch adapted for retaining the battery in said cavity, said latch including at least one annular member, said annular member adapted for engaging with the battery to retain the battery in said cavity;
a release member coupled with said at least one annular member, said release member adapted to be activated to move said annular member to a release position to enable the battery to be removed from the device; and
spring means for biasing said annular member between a normally engaged position and its release position, said spring means coupled with said at least one annular member.

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65. The device according to claim 64, wherein said cavity includes at least one projection for supporting said spring means and for locating said latch in said normally engaged position.

66. The device according to claim 64, further including at least one pair of opposed openings in said cordless device for enabling grasping of the battery for removal from said cordless device.

67. The retention latch according to claim 64, wherein said at least one annular member is a continuous ring.

68. The retention latch according to claim 64, wherein said at least one annular member is an open ring.

69. The retention latch according to claim 64, wherein said release member and spring means are positioned on said annular member opposing one another.

70. The retention latch according to claim 67, wherein said annular ring has an elliptical opening and is divided into first, second, third and fourth ring portions, said first ring portion opposing said fourth ring portion and said second and third ring portions opposing one another and connecting said first and fourth ring portions, said first and fourth ring portions having different radii.

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71. The retention latch according to claim 70, wherein said first ring portion is adapted to engage the battery to removably retain the battery in the device.

72. The retention latch according to claim 71, wherein said first ring portion includes an angled face acting as a cam surface for assisting in enabling passing of the battery through the annular member.

73. The retention latch according to claim 70, wherein when said first ring portion engages the battery in an engaged retention position, said second, third and fourth ring portions disengage the battery.

74. The retention latch according to claim 70, wherein when the release member is activated to move the annular member to a release position, the first ring portion disengages from the battery and the first, second, third and fourth ring portions move without bowing to enable removal of the battery.

75. The retention latch according to claim 70, wherein said first ring portion has a thickness greater than a thickness of the second, third and fourth ring portions.

76. The retention latch according to claim 70, wherein said spring means is integral with said first ring portion.

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77. The retention latch according to claim 76, wherein said spring means is a spring arm extending from said first ring portion.

78. The retention latch according to claim 77, wherein said spring arm is adapted to locate said latch in the device.

79. The retention latch according to claim 66, wherein said spring means is a spring arm extending from said annular member.

80. The retention latch according to claim 75, wherein said spring arm is adapted to locate said latch in the device.

81. The retention latch according to claim 68, wherein said at least one annular member has an overall open figure eight configuration being divided into two ring sections having a continuous inner opening and open on one side.

82. The retention latch according to claim 81, wherein each ring section includes a release member and a spring means.

83. The retention latch according to claim 82, wherein each said release member is positioned on said ring section opposing its respective spring means.

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84. The retention latch according to claim 83, wherein each ring section has an overall C shape with the C shapes opposing one another continuous at one end and open at its other end with each said release member coupled with said C shaped ring section adjacent the open end.

85. The retention latch according to claim 84, wherein each said C shaped ring section includes an engaging portion opposing said release member.

86. The retention latch according to claim 85, wherein each said engaging portion includes a raised arcuate flange integrally formed on said engaging portion.

87. The retention latch according to claim 86, wherein each said arcuate flange engages said battery in an engaged retention position and the remainder of the C shaped ring section disengages the battery.

88. The retention latch according to claim 87, wherein when said release member is activated, to move the C shaped ring section to its release position, said flange disengages from the battery and the remainder of the C shaped ring section bends slightly while the spring means bends enabling removal of the battery.

89. The retention latch according to claim 88, wherein said spring means is integral with said engaging portion.

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90. The retention latch according to claim 89, wherein said spring means includes at least one spring arm extending from said engaging portion.

91. The retention latch according to claim 90, wherein said spring means includes a pair of spring arms.

92. The retention latch according to claim 90, wherein said spring arms are adapted to locate the latch in the device.

93. The retention latch according to claim 82, wherein said spring means includes at least one spring arm extending from said annular member.

94. The retention latch according to claim 93, wherein said spring means includes a pair of spring arms.

95. The retention latch according to claim 93, wherein said spring arms are adapted to locate the latch in the device.

96. A method for removing a battery from a cordless device comprising:
providing a cordless device having a housing, a cavity for receiving a battery in said housing, and at least one pair of opposing openings in said housing extending into said cavity, and a latch in the cordless device for retaining the battery in the cavity, said latch including at least one annular member to engage the battery, a release member coupled with the annular member, and a spring means for biasing said annular member between a normally engaging position and its release position, said spring means coupled with said annular member;
activating said release member to move said annular member from its normally engaged position to its release position;
removing the battery from the device cavity.

97. The method of claim 96, wherein a user may use one hand to remove the battery from the device.

98. The method of claim 97 including grasping the battery with an index finger through one opening while pushing on the release member with a thumb of the same hand and pulling the battery out of said cavity.

99. A cap for a battery comprising:
a cylindrical wall having an external surface and an interior diameter adapted to fit onto a housing of a battery pack; and
a groove in said external surface, said groove adapted for receiving a latch for retaining the cap with the latch.

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100. The cap according to claim 99, wherein said cylindrical wall includes at least one open end.

101. The cap according to claim 100, wherein an angled surface is peripherally formed on the external surface adjacent said open end, said angled surface adapted to act as a cam to spread the latch to retain the cap.

102. The cap according to claim 100, wherein said cylindrical wall has two ends, one of said ends being closed.

103. The cap according to claim 102, wherein said closed end is dome shaped.

104. The cap according to claim 99, wherein at least one gripping member is on said external surface.

105. The device according to claim 31, and including spring means for providing an ejecting force upon activation of said release member to remove the battery from said device, said spring means positioned in said cavity.

106. The device according to claim 64, and including spring means for providing an ejecting force upon activation of said release member to remove the battery from said device, said spring means positioned in said cavity.

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107. A battery pack comprising:

- an elongated casing;
- a plurality of cells in the casing;
- a terminal assembly located at one end of the casing and a cap located on the other end of the casing;
- the cap including a cylindrical wall; and
- an annular groove in the cylindrical wall adapted for receiving a latch for retaining the pack in a cordless device.

108. The pack of claim 107, wherein:

- the cap is slidably fitted on the casing;
- the casing has an annular recess; and
- a bead is formed on an interior surface of the cylindrical cap wall and is located in the casing recess to retain the cap on the casing.

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109. A retention latch adapted to be positioned within a device for retaining a battery or the like device, said retention latch comprising:

an overall L-shaped retaining member adapted for engaging with the battery;

a release member coupled with said retaining member, said release member adapted to be activated to move said retaining member to a release position to enable the battery to be removed from the device; and

biasing means for positioning said retaining member within said device and for returning said retaining member to a normally engaged position upon deactivation of said release member, said biasing means coupled with said retaining member.

110. The retention latch according to claim 109, wherein said release member coupled with the vertical leg of the L.

111. The retention latch according to claim 110, wherein said biasing means coupled with the horizontal leg of the L and near the vertical leg.

112. The retention latch according to claim 110, wherein a cam element is positioned at an end of the horizontal leg of the L, said cam element adapted for engaging the battery.

113. The retention latch according to claim 112, wherein said cam element includes a cam face which enables the battery to pass by the retention device.

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114. The retention latch according to claim 113, wherein said cam element includes a retaining face opposing said cam face, said retaining face adapted for engaging the battery to retain the battery in the device.

115. The retention latch according to claim 111, wherein said horizontal leg includes a cut-out for receiving said biasing means.

116. The retention latch according to claim 109, wherein said biasing means being a helical spring.

117. A cordless device comprising:

- a cavity;
- a receptacle in the cavity;
- a battery pack removably located in the cavity, said battery pack including means for electrically coupling with said receptacle; and
- a latch including an overall L-shaped retaining member adapted for engaging with the battery, a release member coupled with said retaining member, said release member adapted to be activated to move said retaining member to a release position to enable the battery to be removed from the device, and biasing means for positioning said retaining member within said device and for returning said retaining member to a normally engaged position upon deactivation of said release member, said biasing means coupled with said retaining member.

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118. The cordless device according to claim 117, wherein said release member coupled with the vertical leg of the L.

119. The cordless device according to claim 118, wherein said biasing means coupled with the horizontal leg of the L and near the vertical leg.

120. The cordless device according to claim 118, wherein a cam element is positioned at an end of the horizontal leg of the L, said cam element adapted for engaging the battery.

121. The cordless device according to claim 120, wherein said cam element includes a cam face which enables the battery to pass by the retaining member.

122. The cordless device according to claim 121, wherein said cam element includes a retaining face opposing said cam face, said retaining face adapted for engaging the battery to retain the battery in the device.

123. The cordless device according to claim 119, wherein said horizontal leg includes a cut-out for receiving said biasing means.

124. The cordless device according to claim 117, wherein said biasing means being a helical spring.

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125. A cordless device comprising:

a cavity;

a receptacle in the cavity;

a battery pack removably located in the cavity, said battery pack

including means for electrically coupling with said receptacle;

a biasing means in said cavity for ejecting said battery pack from said cavity;

means for holding said battery pack in said cavity against an ejecting force of said biasing means, said holding means positioned in said cavity; and

a latch for retaining said battery pack in said cavity such that upon release of said latch, said battery pack being partially ejected from said cavity by the ejecting force from said biasing means and is held in said cavity against the ejecting force by said holding means.

126. The cordless device according to Claim 125, wherein said holding means including an annular member with at least one retention finger for engaging and retaining said battery pack.

127. The cordless device according to Claim 126, wherein further including a plurality of circumferentially spaced fingers for engaging and retaining said battery pack.

128. The cordless device according to Claim 125, wherein said holding means is axially slid able in said cavity.

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129. The cordless device according to Claim 125, wherein said annular member includes a cam surface for enabling said battery pack to pass by said annular member.

130. The cordless device according to Claim 126, wherein said finger includes a detent for coupling with said battery pack.

131. The cordless device according to Claim 125, wherein said holding means coupled with said receptacle.

132. The cordless device according to Claim 131, wherein said holding means including a member for removably coupling with said battery pack such that said member retains said battery pack in the cavity against said ejecting force.

133. The cordless device according to Claim 131, wherein said member is axially movable in said cavity.

134. The cordless device according to Claim 132, wherein said member includes a plurality of spaced fingers for coupling with said battery electronically coupling means.

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135. The cordless device according to Claim 117, wherein said battery pack includes a cap having a cylindrical wall and an annular groove in the cylindrical wall adapted for receiving said retaining member of said latch for retaining the pack in the cordless device.

136. The cordless device according to Claim 125, wherein said holding means is unitarily formed with said biasing means.

137. The cordless device according to Claim 136, wherein said holding means further includes an arm in said cavity extending from said housing, said arm adapted to engage an annular recess in said battery pack to retain said battery pack in the cavity in an unlatched condition.

138. The cordless device according to Claim 137, wherein said holding means is coupled with said receptacle.

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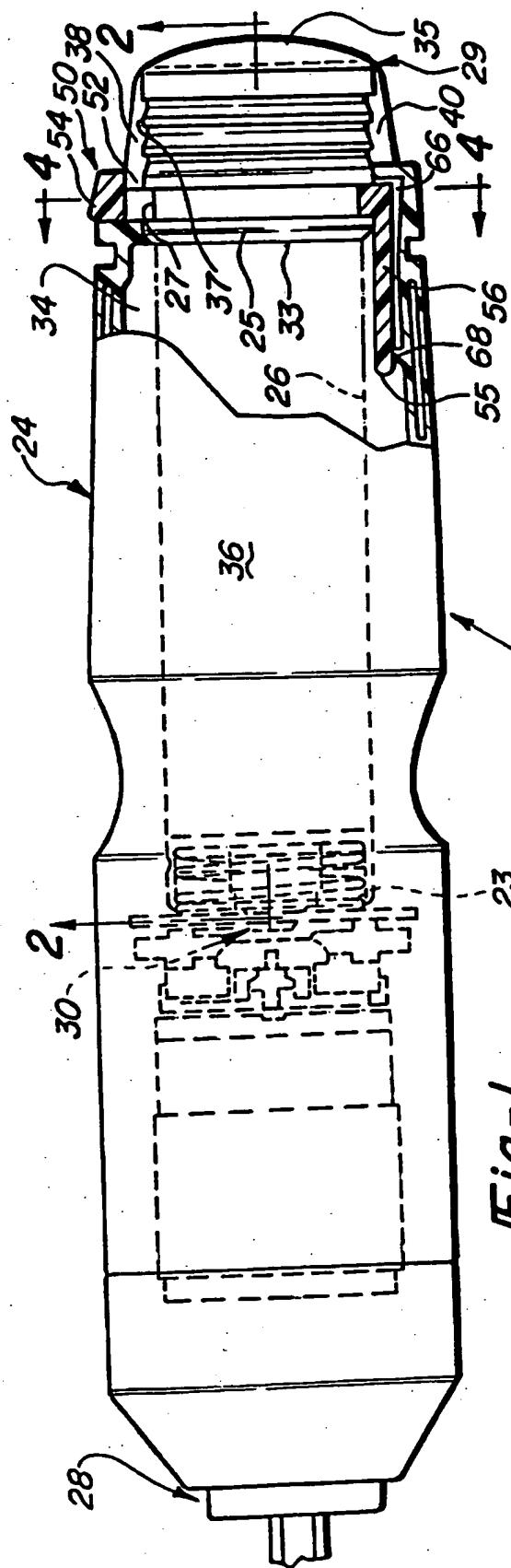


Fig. 1

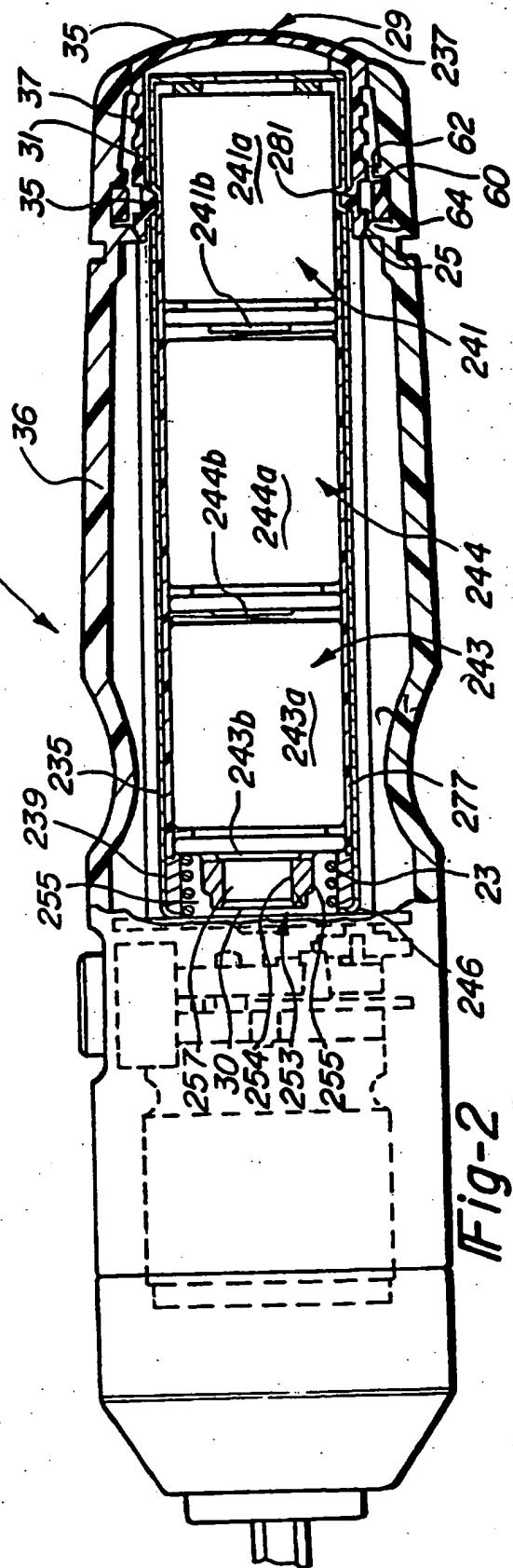
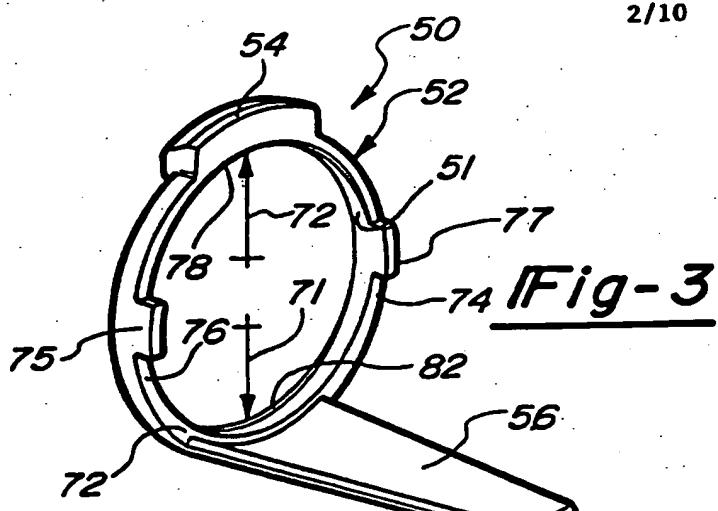
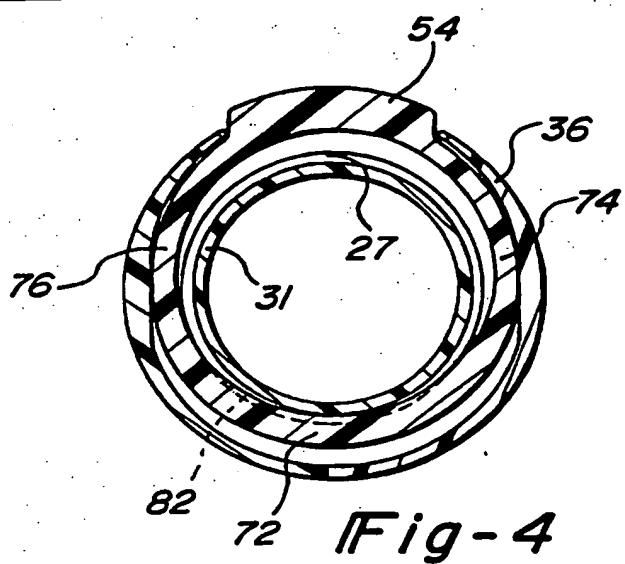
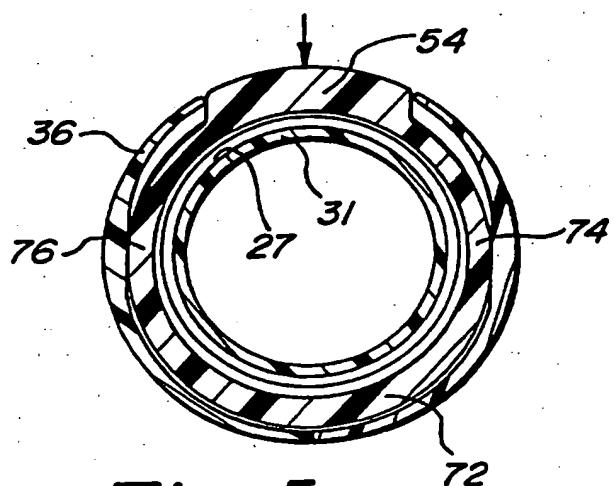
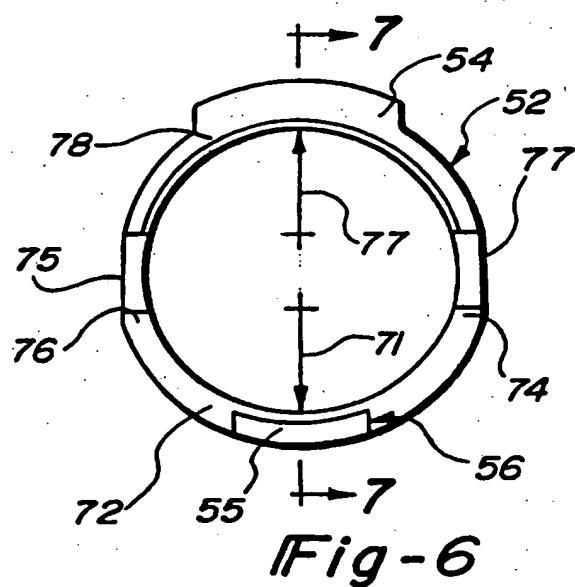
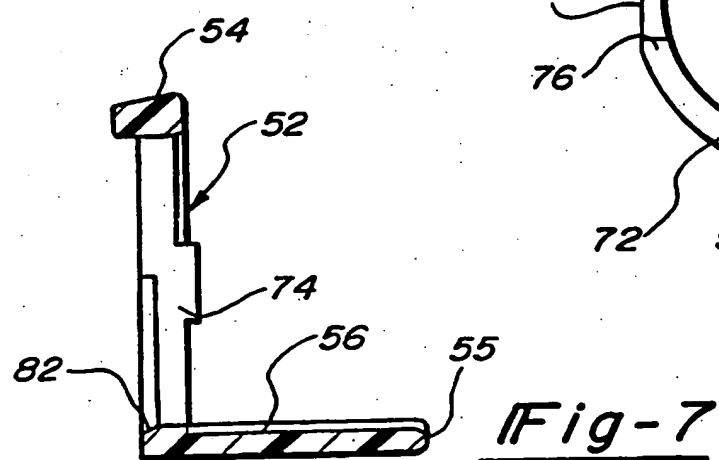
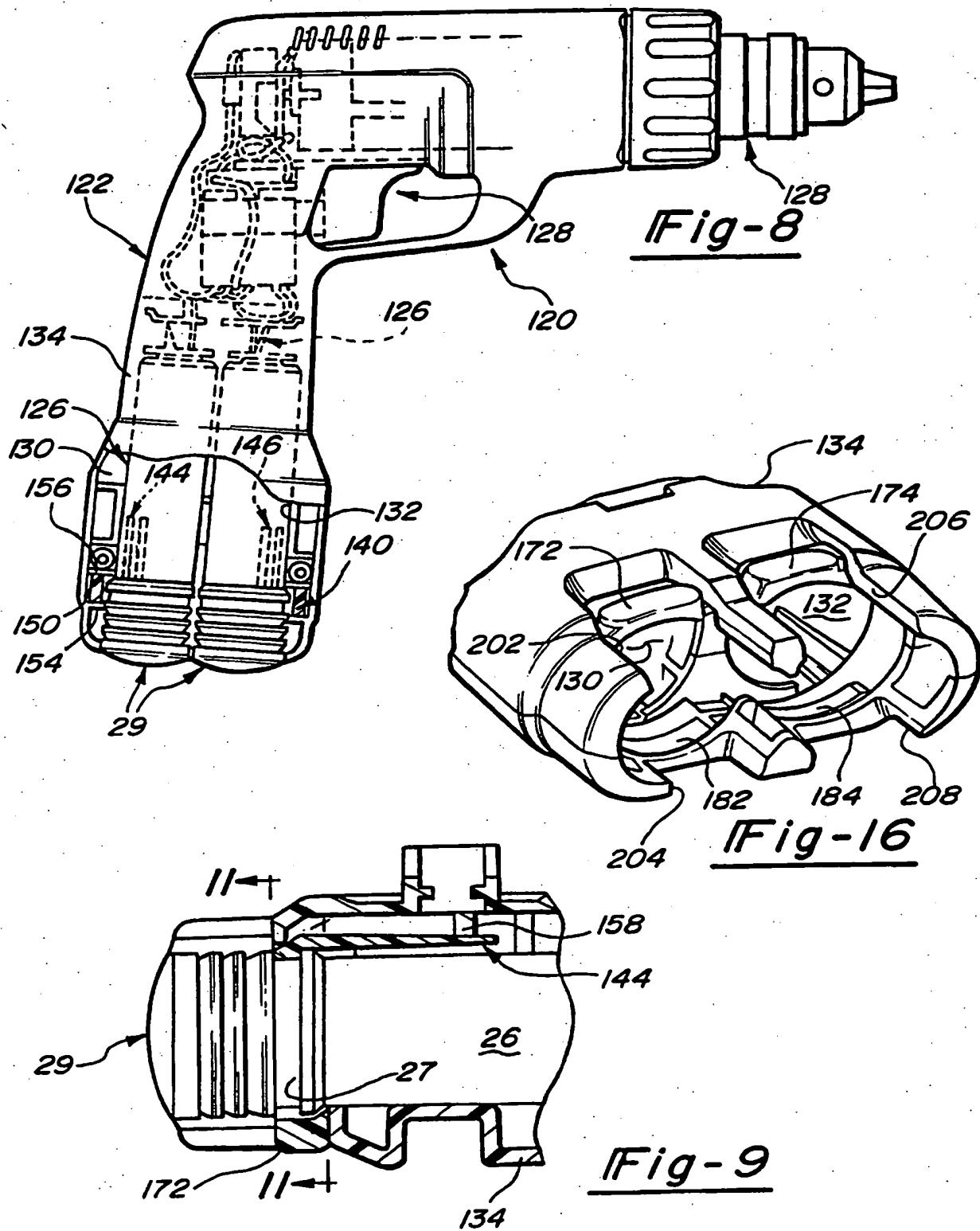


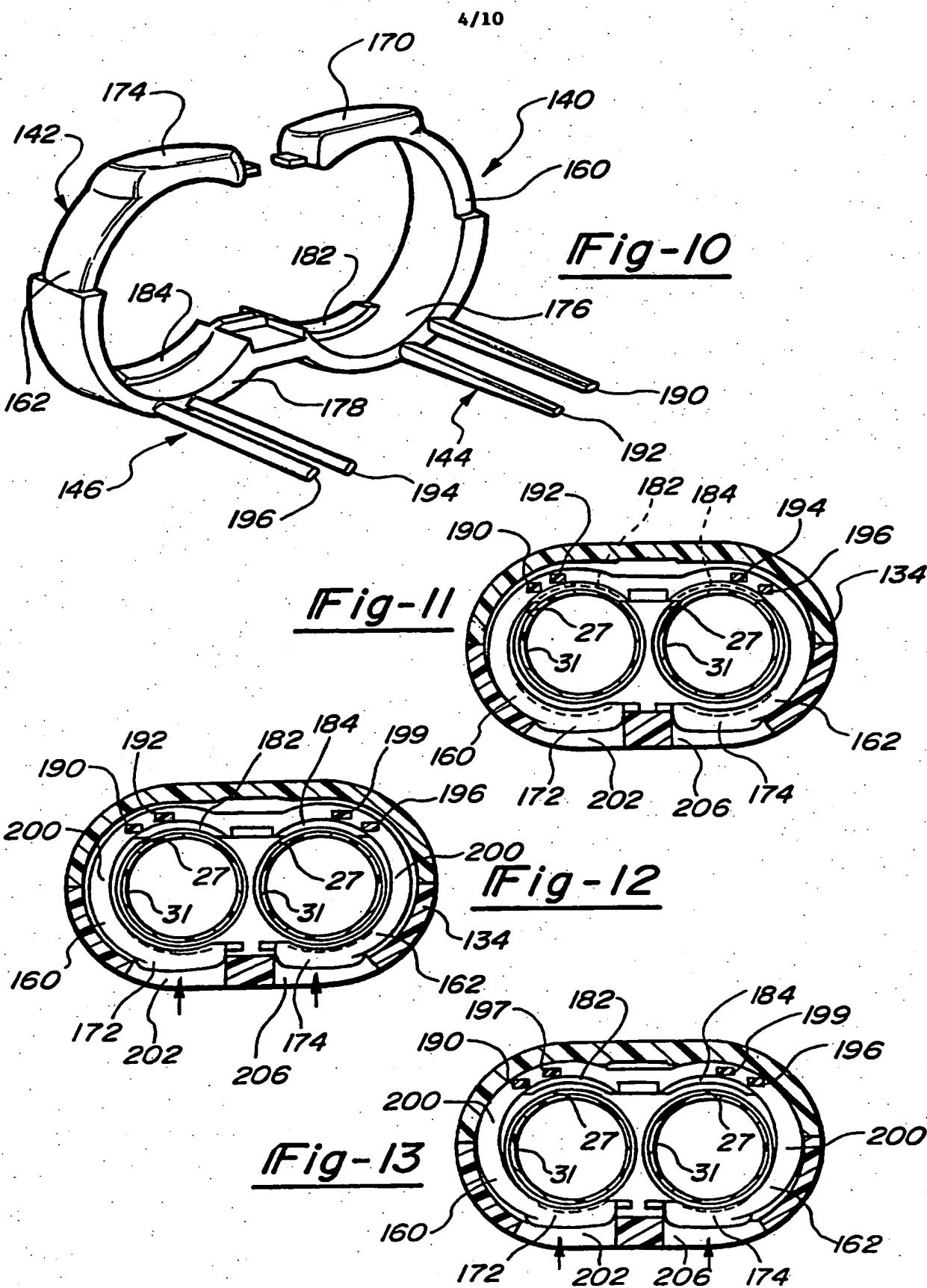
Fig-2

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Fig-3Fig-4Fig-5Fig-6Fig-7

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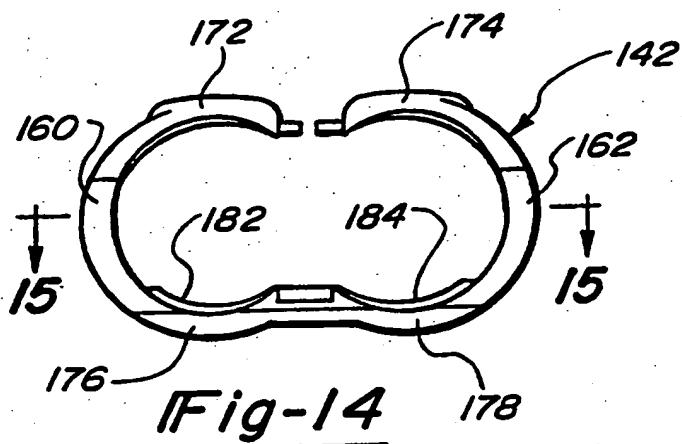


Fig-14

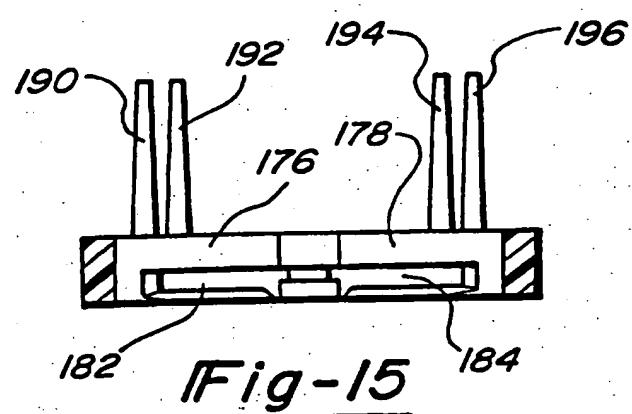


Fig-15

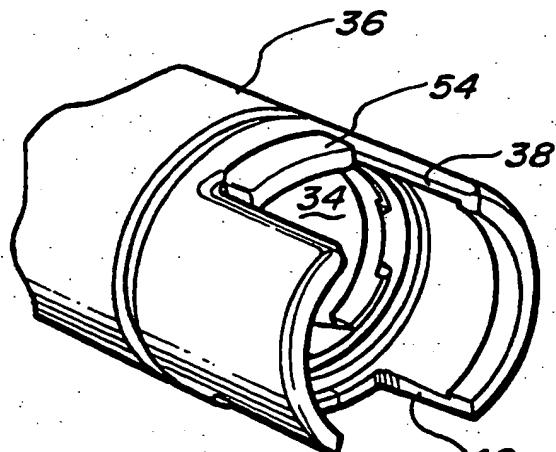


Fig-17

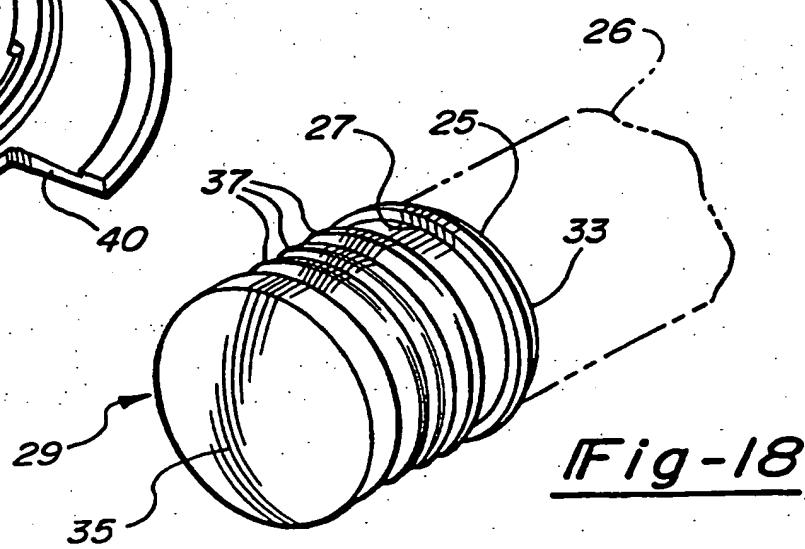


Fig-18

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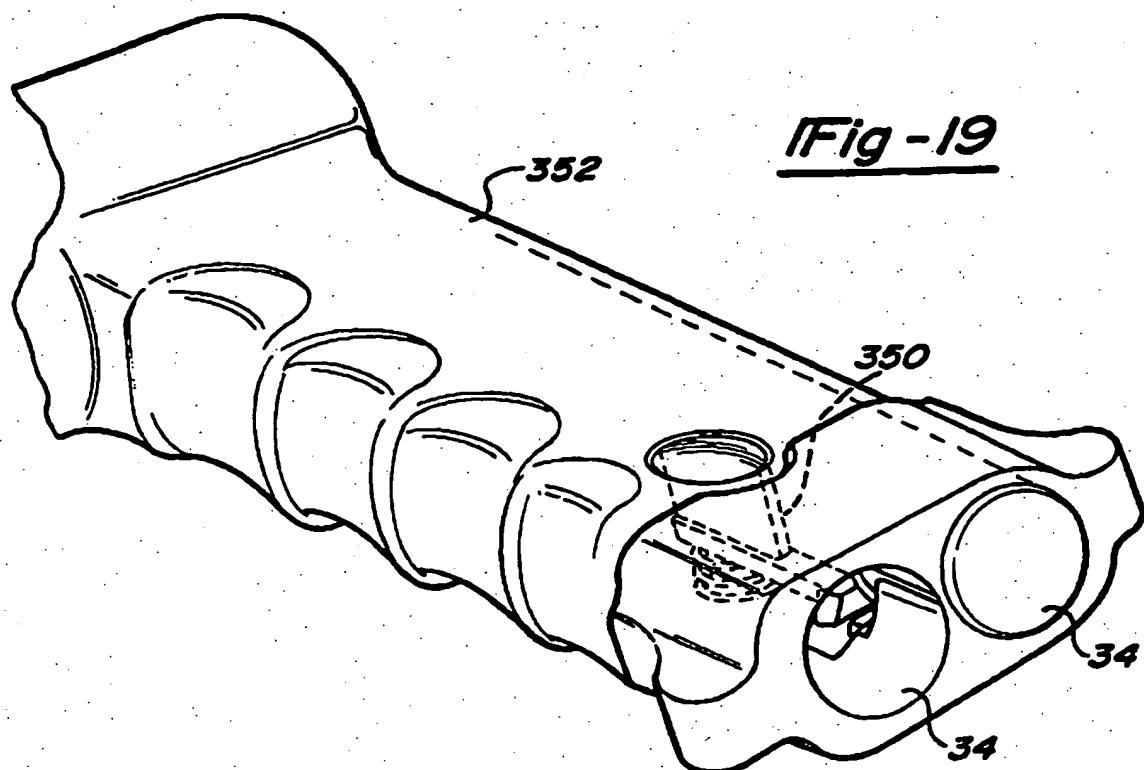


Fig -19

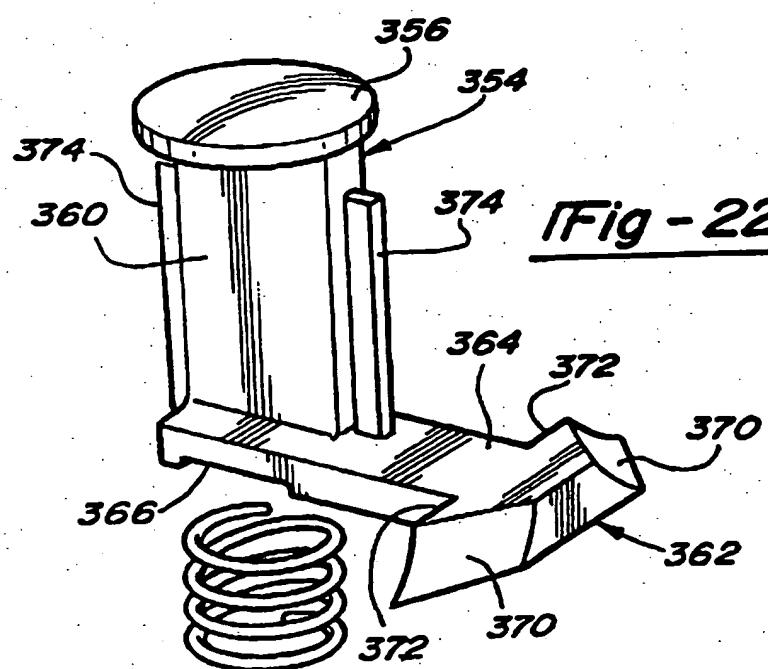


Fig -22

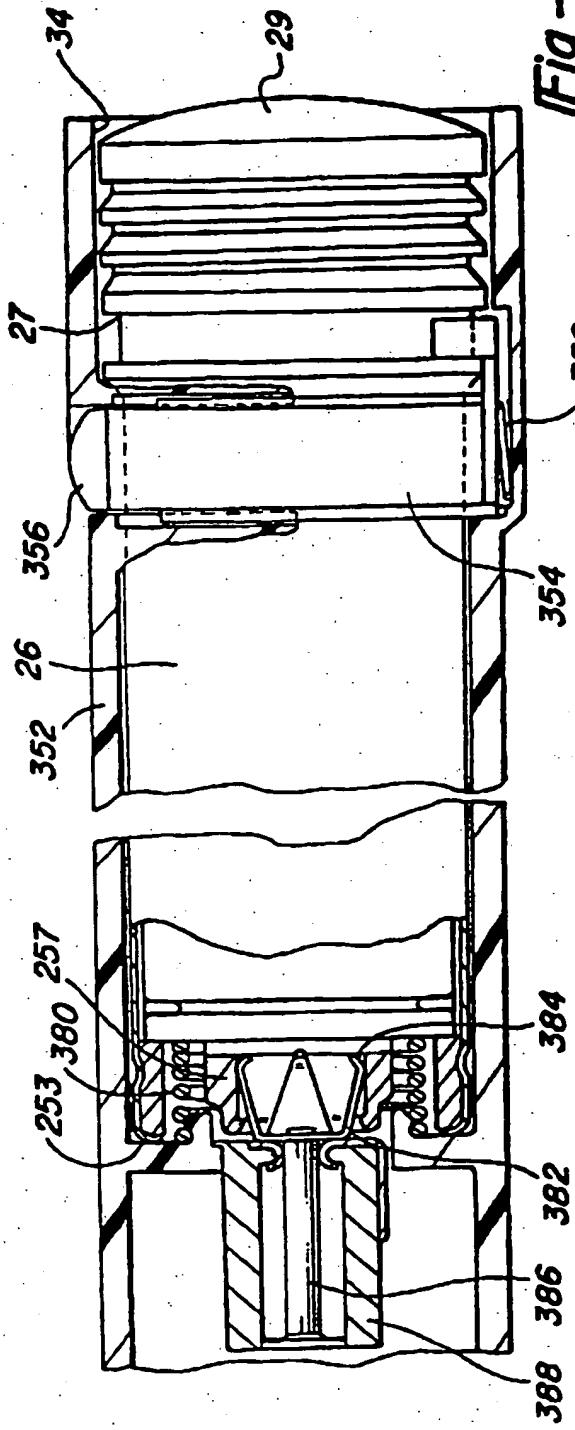


Fig. 20

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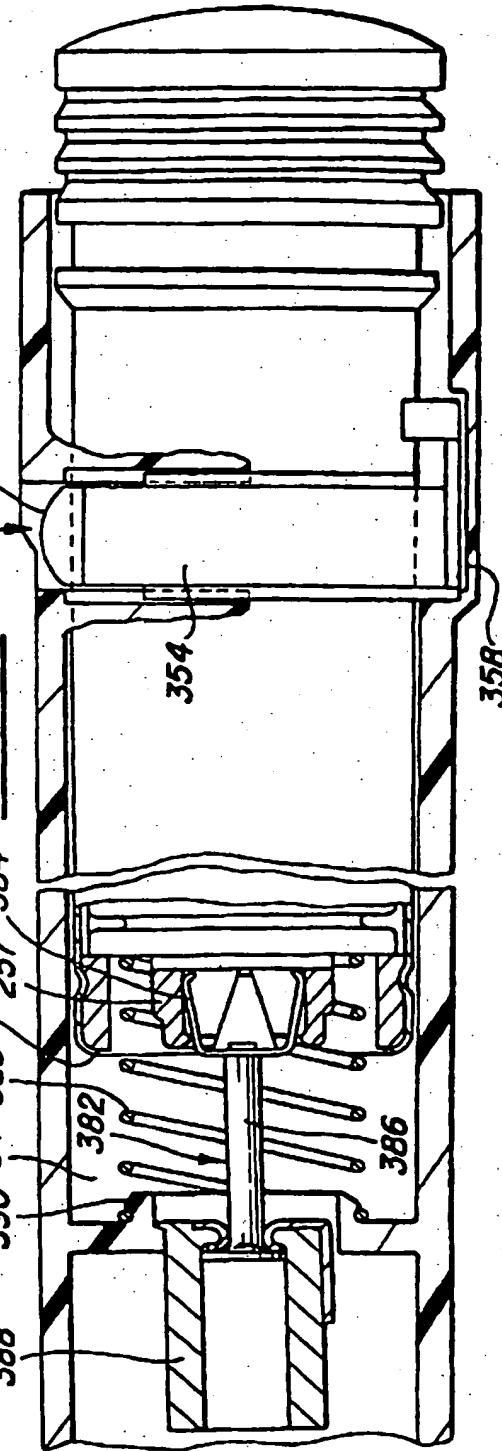


Fig. 21

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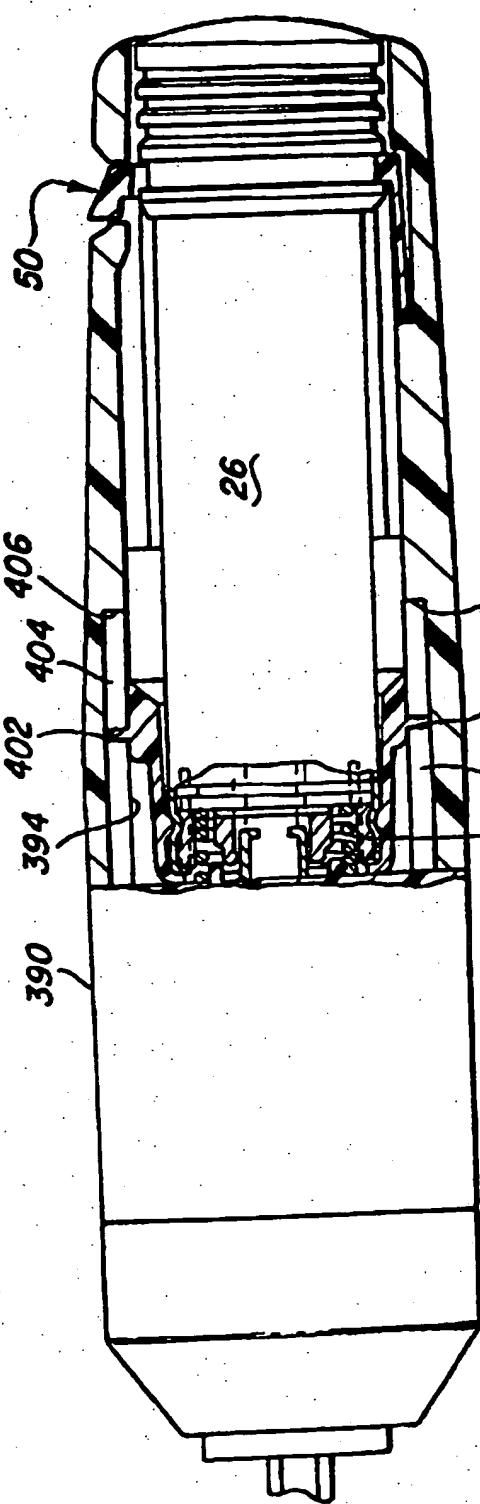


Fig. 23
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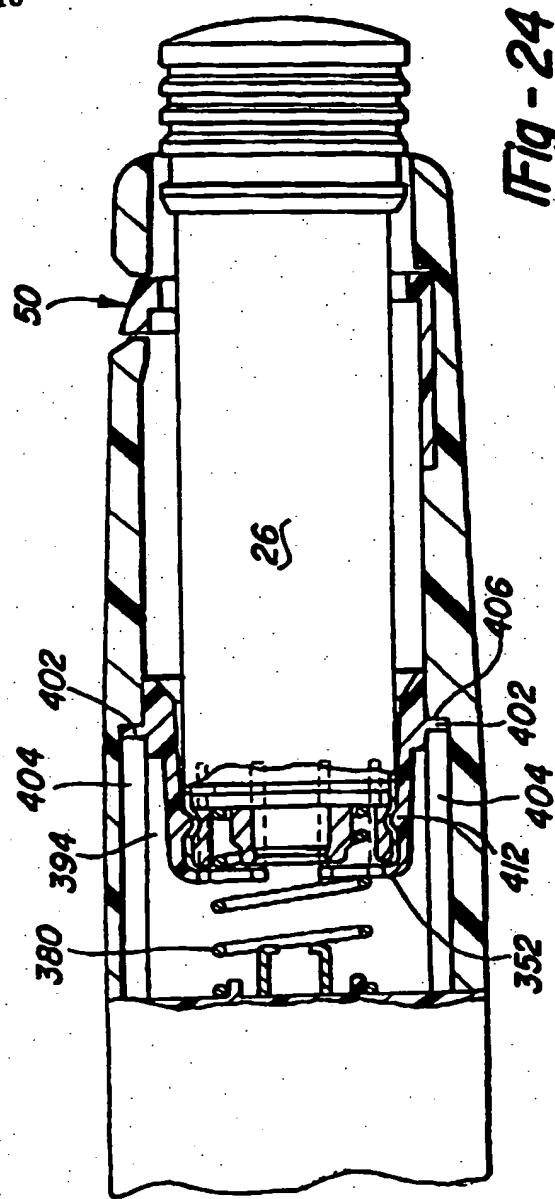
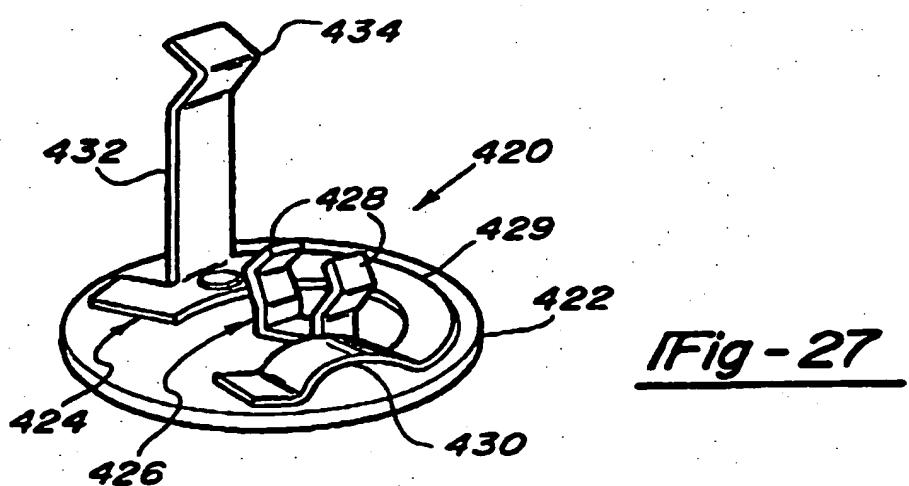
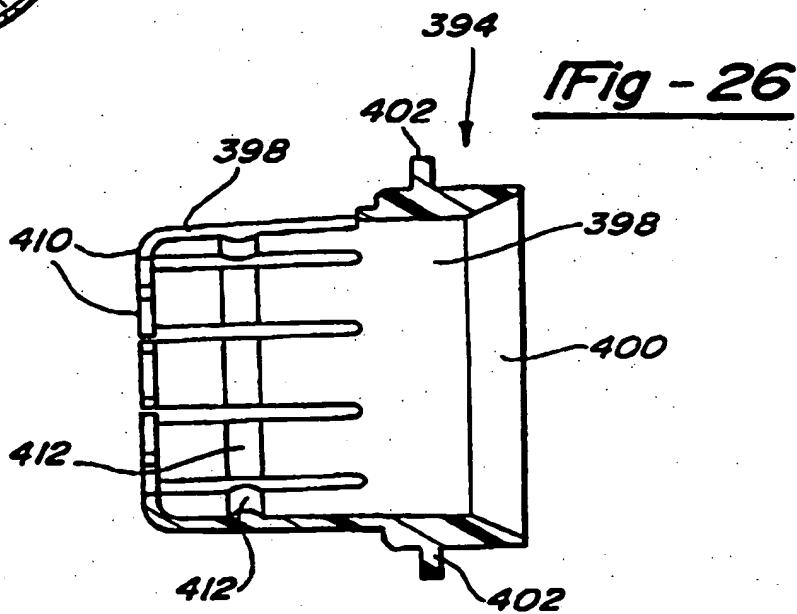
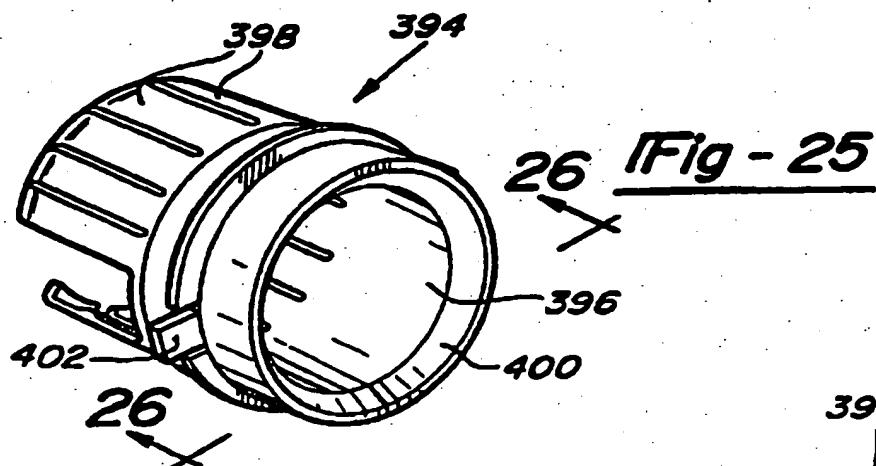


Fig. 24

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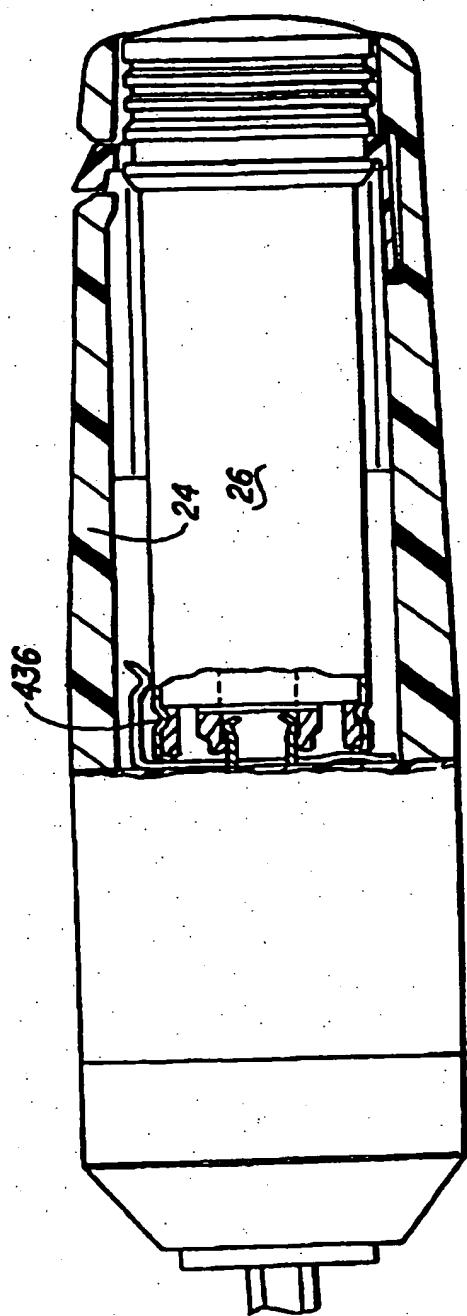


Fig-28

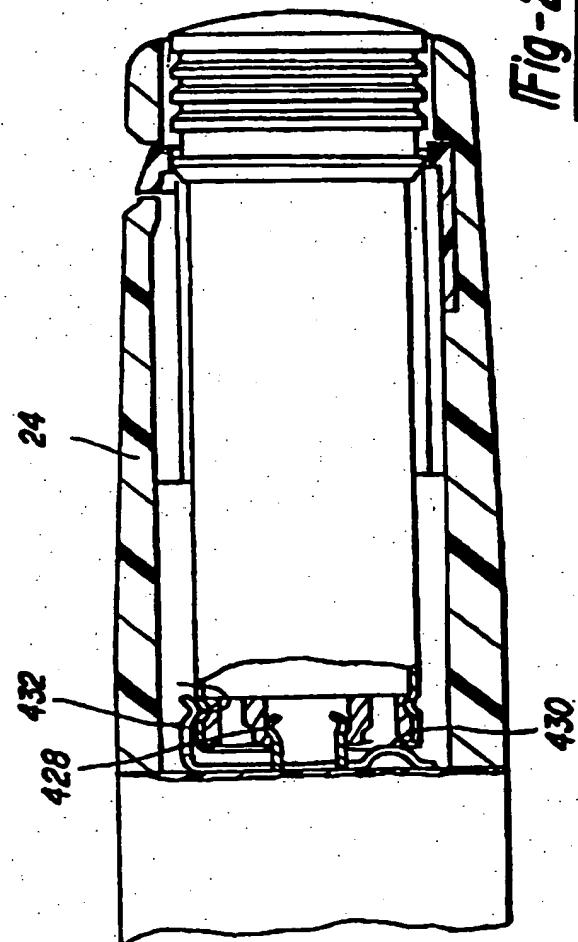


Fig-29

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 95/10167A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01M2/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 532 194 (LIAUTAUD JAMES P ET AL) 30 July 1985 see claims 1-9 ---	1-138
A	EP,A,0 528 478 (SKIL NEDERLAND NV) 24 February 1993 see claims 1-8 ---	1-138
A	US,A,3 999 110 (RAMSTROM LEE WEBBER ET AL) 21 December 1976 see claims 1-33 -----	1-138

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Date of the actual completion of the international search

18 December 1995

Date of mailing of the international search report

12.01.96

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Battistig, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int'l Application No

PCT/US 95/10167

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4532194	30-07-85	NONE	
EP-A-0528478	24-02-93	AU-A- 2063592	11-02-93
US-A-3999110	21-12-76	NONE	

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